Space Weather Forecast

Issued on Thursday, 23 March 2023 at 13:03 Local

This forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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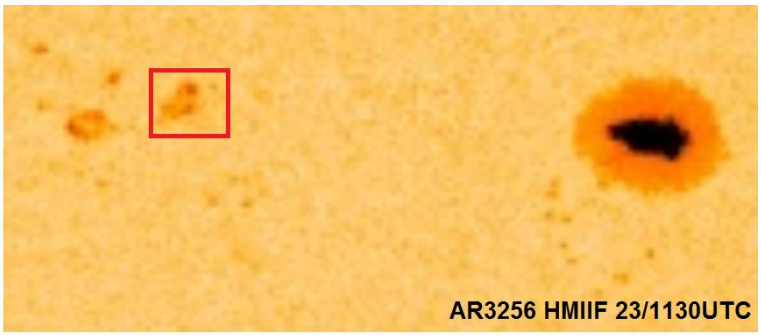
Space Weather Forecast Headline: G1 Minor Geomagnetic Storm likely from imminent CME and/or fast wind arrivals. Daily chance of R1/R2 Radio Blackouts.

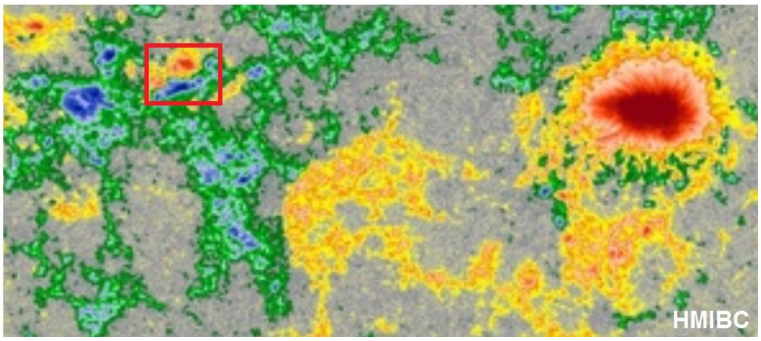
Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been low over the past 24 hours, with X-ray activity peaking with a small common-class flare at 22/1957UTC from the largest sunspot group, else following a decreasing trend in both cadence and level of flares. There are currently up to six sunspot regions on the Sun, with a further region having departed the front-side over the southwestern solar horizon in the period.

Nominally the largest and most complex region on the Earth-facing side is now near the south-centre portion of the Sun, and is showing a proliferating trailing region. While on paper a simpler region, a second sunspot group in the northeast was the only other sunspot to show a growing trend in the 24 hours. All other regions were stable.

Figure 1: Latest visible and magnetic satellite imagery of the largest and most active sunspot region, showing a potentially unstable configuration in its developing trailing portion (where opposing magnetic polarities meet within the same 'penumbra' - boxed red). This has not yet borne fruit (in terms of X-ray flare activity).





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A large 'filament' (arc of plasma) currently circumscribes a large part of the northern polar region of the Sun on the front side, however this remains stable at the time of writing. The only Coronal Mass Ejection (CME) candidates seen on available imagery in the period have either been well to the east of the Sun-Earth line, else low-latitude and far-sided, all to no expected effect at Earth.

Solar Wind / Geomagnetic Activity: The solar wind was initially reflective of gradual easing of a fast wind regime. This gave way to a Co-rotating Interacting Region (CIR) or CME-like rising number of particles and their magnetic fields later in the UTC morning. The cause of this bow wave-like enhancement is not certain at the time of writing, but may comprise one of the outstanding 20 March CMEs, else the anticipated CIR leading an expected fast wind, or perhaps a combination of some or all of the above. The best fit to evidence at present is the northeast-heading 20 March filament CME being the main culprit, although this remains to be seen in the coming hours as it depends on the evolution of current observations.

The solar wind initially fell from elevated levels before a late rally to almost recover all the lost ground by the period's end. The number of particles in the wind was initially near background, but it underwent a late increase to become slightly elevated. The magnetic field associated with these particles was mainly stable and at background levels until after 23/0600UTC, whereupon a rise to slightly elevated levels took place, with the north-south component strongly anti-aligned with Earth's field.

The net result of the above solar wind measures was a provisional increase from quiet geomagnetic activity, reaching a late peak just shy of Minor Storm G1 in the 09-12UTC interval.
Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10MeV) as measured at GOES16 is now close to Background levels.

Four-Day Space Weather Forecast Summary

Solar Activity: Generally Low Solar activity is expected, with a daily chance of isolated Moderate-class flares, mainly from the largest sunspot or from one of several returning regions due onto the disc form the far-side in the period.

Solar Wind / Geomagnetic Activity: Two CMEs feature in the forecast - one overdue and one nominally imminent. They may have combined en-route. The sources of these are: firstly, an event off the southwest of the Sun on 20 March (now overdue); and secondly, a northeast 'filament eruption' on 20 March due imminently.

The forecast otherwise comprises imminent exit from a mature fast wind, and the lapse into a second elevated or strong fast wind later on day 1 (Thursday 23 March), potentially preceded by a notable CIR region, and potentially bolstered by the outstanding CMEs. Elevated winds are then expected to continue for much of the rest of the period.

During day 1 (Thursday 23 March), the combined effect of CME arrival(s) and the fast wind enhancement is likely to increase activity to G1/Minor Storm intervals, with a chance of G2/Moderate storms given suitable alignment. Any enhanced activity is likely to continue day 2 (Friday 24 March), but gradually ease back to mainly quiet levels from day 3 (Saturday 25 March).

Energetic Particles / Solar Radiation: High energy (greater than 10MeV) proton flux is expected to continue close to Background, with only a slight chance of further enhancements should any significant flares occur.

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Geomagnetic Storms:

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	60	40	10	1
Strong	G3	No	10	5	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Radio Blackouts - X Ray Flares:

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 M Class	No	25	25	25	25
Very Active	R3 to R5 X	No	5	5	5	5

Solar Radiation Storms - (High Energy Protons):

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ S1	No	5	5	5	5
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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